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FLOOD INSURANCE STUDY

TOWN OF NORWICH, VERMONT
WINDSOR COUNTY

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JUNE 15, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 500295

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWN OF NORWICH, WINDSOR COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Norwich, Windsor County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were taken from the Flood Plain Management Study prepared by the Soil Conservation Service (SCS) and from the Flood Insurance Study for the Town of Hanover, New Hampshire, prepared for the Federal Emergency Management Agency (FEMA).

1.3 Coordination

On July 16, 1986, the Town of Norwich was notified by FEMA of the initiation of a Flood Insurance Study for the community.

On January 7, 1987, a final Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA and the Town of Norwich.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Norwich, Windsor County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: the Connecticut River, from the downstream corporate limits to the upstream county boundary; the Ompompanoosuc River, from its confluence with the Connecticut River to the upstream county boundary; Bloody Branch, from Elm Street to approximately 1.1 miles upstream of Turnpike Road (5th crossing); and New Boston Brook, from approximately 100 feet above New Boston Road (4th crossing) for approximately 0.6 mile upstream. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

An unnamed tributary to the Connecticut River was studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

2.2 Community Description

The Town of Norwich is located in east-central Vermont. It is bordered by the Town of Hartford to the south; the Town of Thetford to the north; the Town of Hanover, New Hampshire, to the east; and the Town of Sharon to the west.

Soils in the town are generally deep, sandy, and gravelly complexes (Adams-Colton-Duxbury association) along the Connecticut River, with a transition to the uplands that consist mainly of shallow to moderately deep, loamy soils, such as the Tunbridge-Woodstock-Colrain association. A soil survey of Windsor County is currently in progress and is scheduled for completion in 1988.

The town is located at 43 degrees to 45 feet north latitude and has a cool, moist climate. Average annual precipitation is 37 inches, which includes an average of 75 inches of snowfall; approximately 18 inches leaves the land as surface runoff. The mean annual temperature is 44 degrees Fahrenheit (^{o}F) with a minimum of 35^{o}F in winter and a maximum of 90^{o}F in summer.

2.3 Principal Flood Problems

The Town of Norwich has experienced severe flooding during March 1913, November 1927, March 1936, September 1938, June 1973, and August 1976. The November 1927 flood was the flood of record on the Connecticut River in the community (considered greater than a

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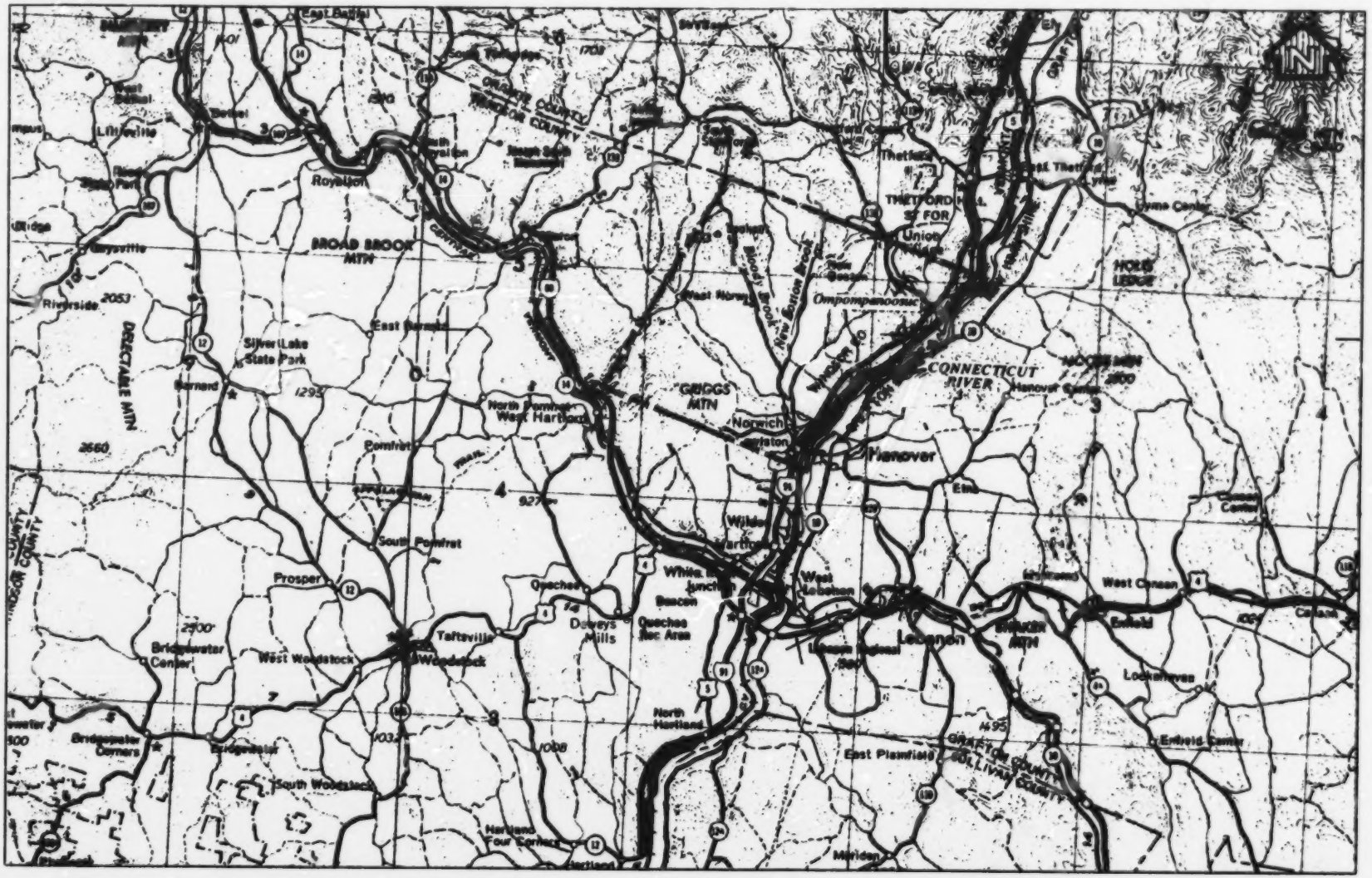

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT

(WINDSOR COUNTY)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

100-year event) while the June 1973 flood was more severe along the tributaries. The worst of the tributary flood damages have occurred along Bloody Brook. Flood damage along the Connecticut River have been worse in the area near the confluence of the Ompompanoosuc River. Figures 2, 3, 4, and 5 show 100-year flood heights at selected locations.

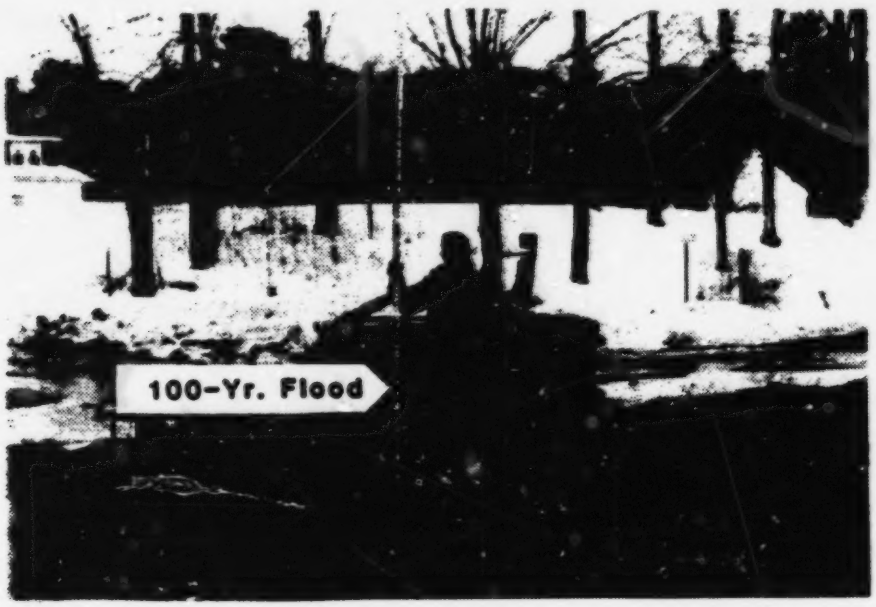

Figure 2 - 100-year flood height at junction of Turnpike Road and New Boston Road just north of bridge over Bloody Brook

Depths of flow along the tributaries for the 100-year flood range from approximately 5 to 13 feet. The 100-year flood velocities in the channel range from 2 to 16 feet per second. These values were determined under the assumption that bridges, culverts, and other flow restrictions are clear of debris.

The hydrologic conditions are expected to remain approximately the same for the foreseeable future. Development has occurred primarily in the lower portions of the tributaries where effects on stream flooding are generally less. Unless managed development of the floodplain is implemented, the possibility of raised flood heights from floodplain encroachment could occur. This, as well as employment of conservation practices for protection against increasing runoff from headwater development, should be of primary concern to the townspeople in the future.

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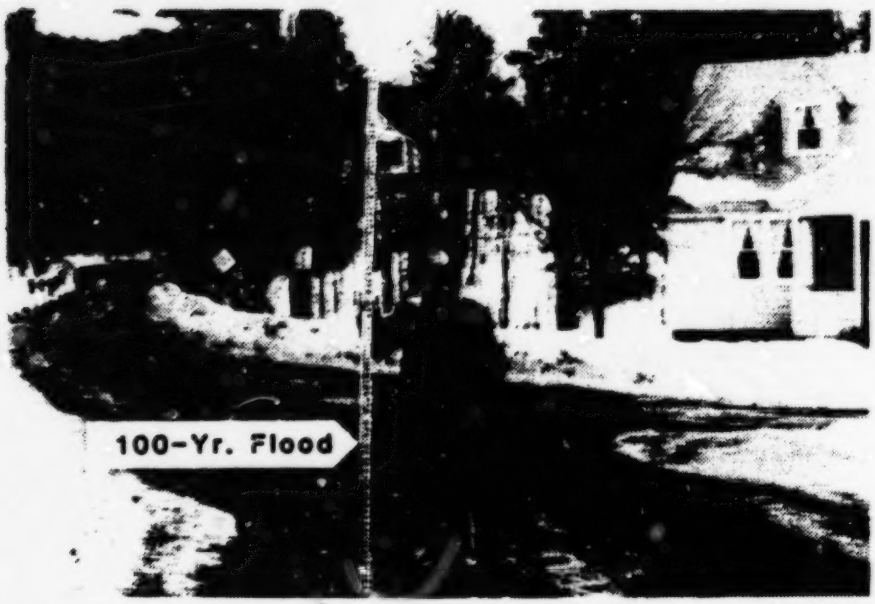

Figure 3 - 100-year flood height looking west approaching bridge over Bloody Brook on crossroad between New Boston and Beaver Meadow Roads.

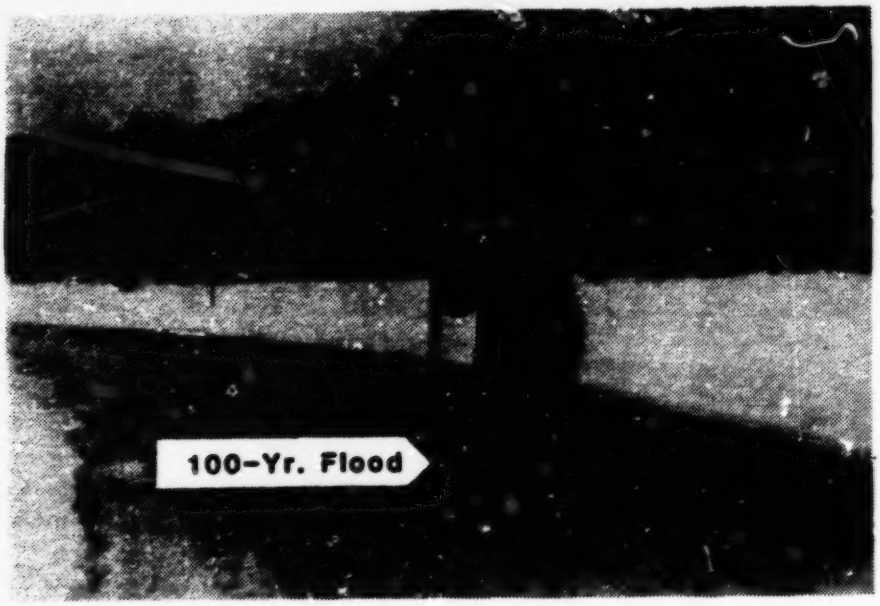

Figure 4 - 100-year flood height on middle of drive at entrance to the Catholic Church off Beaver Meadow Road.

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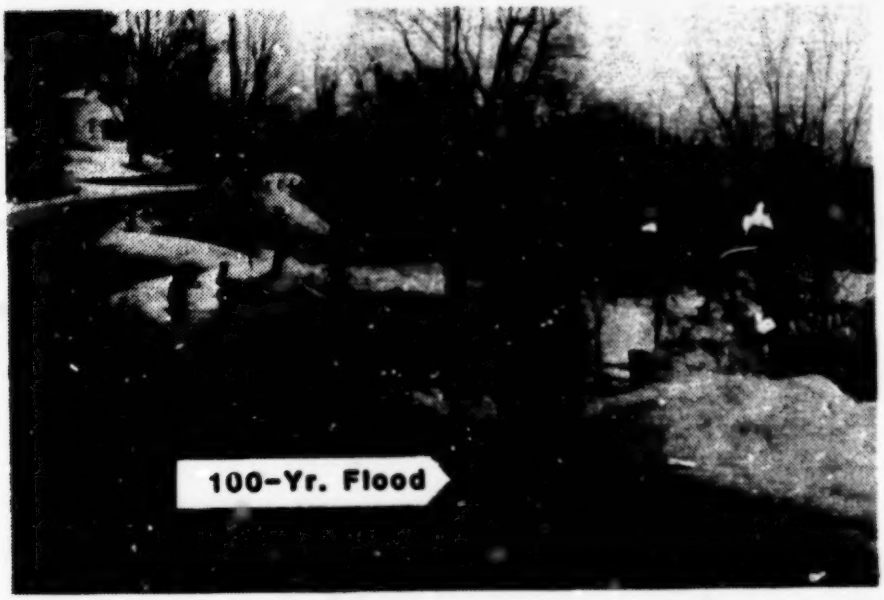

Figure 5 - 100-year flood height looking west approaching bridge over Bloody Brook on Mechanics Street.

2.4 Flood Protection Measures

In Vermont, municipalities have the authority to regulate development in flood hazard areas under Title 24 VSA chapter 91. Title 10 VSA chapter 32 authorizes the Secretary of the Agency of Environmental Conservation to designate flood hazard areas and to assist the towns with flood hazard regulation. Title 25 VSA subsection 4409 requires towns to submit a report to Water Resources before issuing a permit for development in a designated flood hazard area.

Several other laws and regulations administered by the State contain special requirements for development in flood hazard areas. Some of these are:

Act 250 (10 VSA chapter 15) administered by the Environmental Board and District Environmental Commissions;

Health Regulations administered by the Protection Division of the Agency of Environmental Conservation;

Storage of Flammable Liquids (20 VSA section 2721) administered by the State Fire Marshall;

Stream Alteration (10 VSA chapter 28) administered by the Department of Water Resources;

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Dam Construction (10 VSA chapter 29) administered by the Department of Water Resources.

The town has an interim floodplain zoning ordinance in effect. However, the available mapping is not adequate to properly administer the ordinance.

There are two dams that affect the community: Wilder Dam has some affect on the community; and Union Village Dam, which reduces flood flows in the community.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for the Connecticut River was taken from the Flood Insurance Study for the Town of Hanover (Reference 1). In that study, the principal source of data for defining the discharge-frequency relationships for the Connecticut River was taken from a gaging station on the Connecticut River at White River Junction located approximately 3.0 miles downstream from the Town of Hanover. The gage has been in operation since 1911. Values for the 10-, 50-, 100-, and 500-year peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data (Reference 2).

The hydrologic analysis for the Ompompanoosuc River was taken from the Flood Plain Management Study for the Town of Norwich (Reference 3). Discharges were developed along Bloody Brook and New Boston Brook using the SCS computer model described in Technical Release 20 (Reference 4). Flow-frequency values from this hydrologic model were adjusted as necessary in analyzing them along with values from similar gaged watersheds.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Dischatges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CONNECTICUT RIVER					
At downstream corporate limits	3,300	62,243	93,365	108,061	135,725
At upstream corporate limits	3,100	59,535	89,302	103,359	129,819
OMPOMPANOOSUC RIVER					
At confluence with Connecticut River	136.0	*	*	2,599	*
BLOODY BROOK					
At confluence with Connecticut River	18.0	*	*	5,538	*
NEW BOSTON BROOK					
At confluence with Bloody Brook	2.8	*	*	1,018	*

*Data not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses for the Connecticut River were located at close intervals above and below bridges in order to compute the significant backwater effects of these structures in developed areas. Cross sections were also field surveyed between structures. The valley portions of the cross section data for the Connecticut River were obtained photogrammetrically; the below water portions were obtained by field measurement. Bridge plans were

utilized to obtain elevation data and structural geometry. All bridges for which plans were unavailable or out of date were surveyed.

Cross-sectional data for the Ompompanoosuc River, Bloody Brook, and New Boston Brook were obtained by transit surveys and from photomaps drawn using U. S. Geological Survey (USGS) topographic maps and aerial photos as a guide (References 5 and 6). All bridges and culverts were field surveyed to obtain elevation data and structural geometry of the stream and floodplain areas.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2). Along certain portions of the streams studied by detailed methods, channel distances as indicated on the maps may not equal those shown on the flood profiles and floodway data tables.

Water-surface elevations of floods of the selected recurrence intervals for the Connecticut River were computed using the COE HEC-2 step-backwater computer program (Reference 7). Water surface-elevations for the Ompompanoosuc River, Bloody Brook, and New Boston Brook were computed using SCS Technical Release No. 61 (Reference 8). Results were checked against known high-water marks at selected locations. The products of these analyses are the basis for much of the boundary elevation and profile information contained in this study. This study's information reflects coordination with evaluations made by others along the Ompompanoosuc River. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Flood elevations on the Connecticut River at the downstream corporate limits are affected by Wilder Dam, which is located approximately 1.75 miles below the Town of Norwich. Starting water-surface elevations for the Connecticut River were based on the pool elevations that would result from the current procedures used by the New England Power Service Company in operating the dam. Information on starting water-surface elevations for the remaining detailed studied streams was not available.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were based on engineering judgment and field inspections. The following tabulation shows the channel and overbank "n" values for the streams studied by detailed methods:

Stream	Channel "n"	Overbank "n"
Connecticut River	0.025 - 0.040	0.040 - 0.100
Ompompanoosuc River	0.030 - 0.056	0.030 - 0.110
Bloody Brook	0.055 - 0.071	0.030 - 0.110
New Boston Brook	0.030 - 0.052	0.040 - 0.110

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 and 1:62,500 with a contour interval of 20 feet and photomaps at a scale of 1:4,980 (References 6 and 5).

For the stream studied by approximate methods, the 100-year flood boundary was delineated using the Flood Hazard Boundary Map for the Town of Norwich (Reference 9).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the stream studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for the Connecticut River extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 6.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of the Ompompanoosuc River are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Connecticut River								
A	1370[1]	650/0[3]	15,630	6.91	389.5	389.5	390.3	0.8
B	4,435[1]	415/55[3]	12,180	8.79	390.0	390.0	390.7	0.7
C	4,560[1]	385/25[3]	10,285	10.41	390.1	390.1	390.8	0.7
D	7,850[1]	310/0[3]	11,525	9.29	391.5	391.5	392.1	0.6
E	9,315[1]	500/20[3]	13,385	8.00	392.2	392.2	392.8	0.6
F	12,035[1]	320/10[3]	11,390	9.40	392.7	392.7	393.2	0.5
G	17,760[1]	380/40[3]	11,925	8.98	394.2	394.2	394.7	0.5
H	21,660[1]	750/30[3]	17,325	6.18	395.8	395.8	396.2	0.4
I	27,040[1]	670/130[3]	17,090	6.25	396.6	396.6	397.0	0.4
J	36,280[1]	430/0[3]	12,470	8.29	398.1	398.1	398.4	0.3
K	41,460[1]	330/0[3]	12,560	8.23	399.2	399.2	399.4	0.2
Ompompanoosuc River								
A	5,900[2]	168	2,829	0.92	397.5	397.4[4]	398.4	1.0
B	6,180[2]	337	4,973	0.52	397.5	397.4[4]	398.4	1.0
C	8,620[2]	939	8,852	0.29	397.6	397.6	398.6	1.0
D	10,220[2]	428	2,874	0.90	397.6	397.6	398.6	1.0
E	11,740[2]	100	696	2.90	398.3	398.3	399.3	1.0
F	13,660[2]	81	656	3.96	402.1	402.1	403.1	1.0
G	14,980[2]	75	595	4.37	404.8	404.8	405.8	1.0
H	17,400[2]	109	614	4.23	411.1	411.1	412.1	1.0

[1]Feet above corporate limits

[2]Feet above confluence with the Connecticut River

[3]Width/width within corporate limits

[4]Elevations computed without consideration of backwater effects from Connecticut River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT

(WINDSOR COUNTY)

FLOODWAY DATA

CONNECTICUT RIVER - OMPOMPANOOSUC RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Bloody Brook								
A	5,000[1]	59	376	14.75	465.1	465.1	466.1	1.0
B	7,140[1]	57	564	9.74	490.0	490.0	491.0	1.0
C	7,520[1]	98	1,050	5.23	496.3	496.3	497.3	1.0
D	9,440[1]	449	984	5.29	515.0	515.0	516.0	1.0
E	9,900[1]	389	1,122	4.63	518.0	518.0	519.0	1.0
F	11,860[1]	321	884	5.71	538.2	538.2	539.2	1.0
G	13,220[1]	72	512	9.81	554.2	554.2	555.2	1.0
H	15,340[1]	93	492	7.11	590.2	590.2	591.2	1.0
I	15,960[1]	117	488	7.17	599.3	599.3	600.3	1.0
J	17,010[1]	97	459	7.53	619.1	619.1	620.1	1.0
K	17,860[1]	59	337	7.73	634.9	634.9	635.9	1.0
L	20,770[1]	31	220	11.41	695.7	695.7	696.7	1.0
M	21,010[1]	66	348	7.20	701.1	701.1	702.1	1.0
N	21,600[1]	34	222	11.16	717.0	717.0	718.0	1.0
O	21,846[1]	52	353	7.02	721.7	721.7	722.7	1.0
P	23,910[1]	48	270	8.45	759.1	759.1	760.1	1.0
Q	25,862[1]	150	351	5.93	795.8	795.8	796.8	1.0
R	27,332[1]	35	175	7.35	824.4	824.4	825.4	1.0
S	27,552[1]	29	160	8.02	831.0	831.0	832.0	1.0
New Boston Brook								
A	3,452[2]	18	83	12.28	728.4	728.4	729.4	1.0
B	3,537[2]	173	1,058	0.96	732.8	732.8	733.8	1.0
C	6,600[2]	103	363	2.32	736.5	736.5	737.5	1.0

[1]Feet above confluence with Connecticut River
[2]Feet above confluence with Bloody Brook

TABLE 2

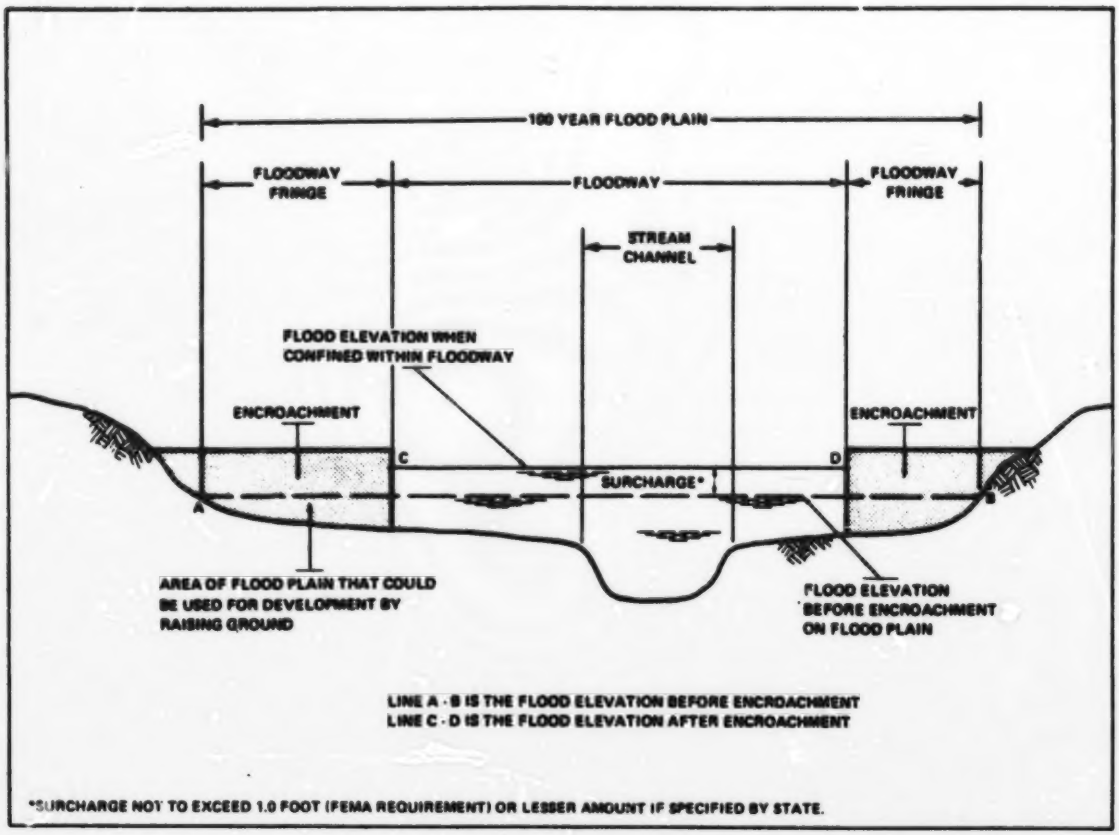
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT

(WINDSOR COUNTY)

FLOODWAY DATA

BLOODY BROOK – NEW BOSTON BROOK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 6

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been published for the Towns of Hanover and Hartford (References 1 and 10). The results of this study are in agreement with the results of those studies.

A Flood Plain Management Study for the Town of Norwich, Vermont, has been published (Reference 3). The results of this study are in agreement with the results of that study.

Due to its more detailed nature, this Flood Insurance Study supersedes the Flood Hazard Boundary Map for the Town of Norwich (Reference 9).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Town of Hanover, Grafton County, New Hampshire, Washington, D. C., July 3, 1978.

2. Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequency," Bulletin 15, Washington, D. C., December 1967.

3. U. S. Department of the Agriculture, Soil Conservation Service, A Flood Plain Management Study for the Town of Norwich, Vermont, Washington, D. C., February 1985.

4. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, Computer Program, Project Formulation, Hydrology, Washington, D. C., 1965.

5. U. S. Department of the Agriculture, Soil Conservation Service, A Flood Plain Management Study for the Town of Norwich, Vermont, Photomaps, Scale 1:4,980: Norwich, Vermont, February 1985.

6. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000 and 1:62,500, Contour Interval 20 Feet: Hanover, New Hampshire-Vermont, 1959, Photorevised 1980; Quechee, Vermont, 1959, Photorevised 1980; Lyme, New Hampshire-Vermont, 1981; Strafford, Vermont, 1944; Mascoma, New Hampshire-Vermont, 1927.

7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, April 1984.

8. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 61, WSP-2 Computer Program, Washington, D. C., May 1976.

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Town of Norwich, Windsor County, Vermont August 8, 1980.

10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Hartford, Windsor County, Vermont, Washington, D. C., July 2, 1979.

U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 64, Floodway Determination Computer Program, Washington, D. C., June 1978.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	02	440.67	Chiseled square on top of north wall of drop inlet approximately 0.5 mile south of covered bridge on west side of State Route 132 in Union Village, west of grass triangle at intersection of Union Village Road.
RM 2	02	466.43	Nail in 3.5 foot elm tree approximately 0.6 mile south of covered bridge on west side of State Route 132 in Union Village, opposite telephone pole No. 87.
RM 3	03	477.13	Chiseled square on center of culvert headwall approximately 1 mile south of covered bridge on west side of State Route 132 in Union Village, 50 feet north of intersection of State Route 132 and Union Village Road.
RM 4	03	476.31	Railroad spike in 24 inch gnarled yellow birch tree on south side of State Route 132, 150 feet east of mile marker 1320-1411-0080.
RM 5	03	473.62	Chiseled square on southeast corner of mile marker 1320-1411-0100 on north side of State Route 132.
RM 6	03	418.52	SCS aluminum disk and nail in large elm on north side of State Route 132, 0.6 mile west of RM 11, near old barn.
RM 7	03	408.55	Spike in bottle cap in GMPC pole 61 on State Route 132, near mile marker 1320-1411-0140.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

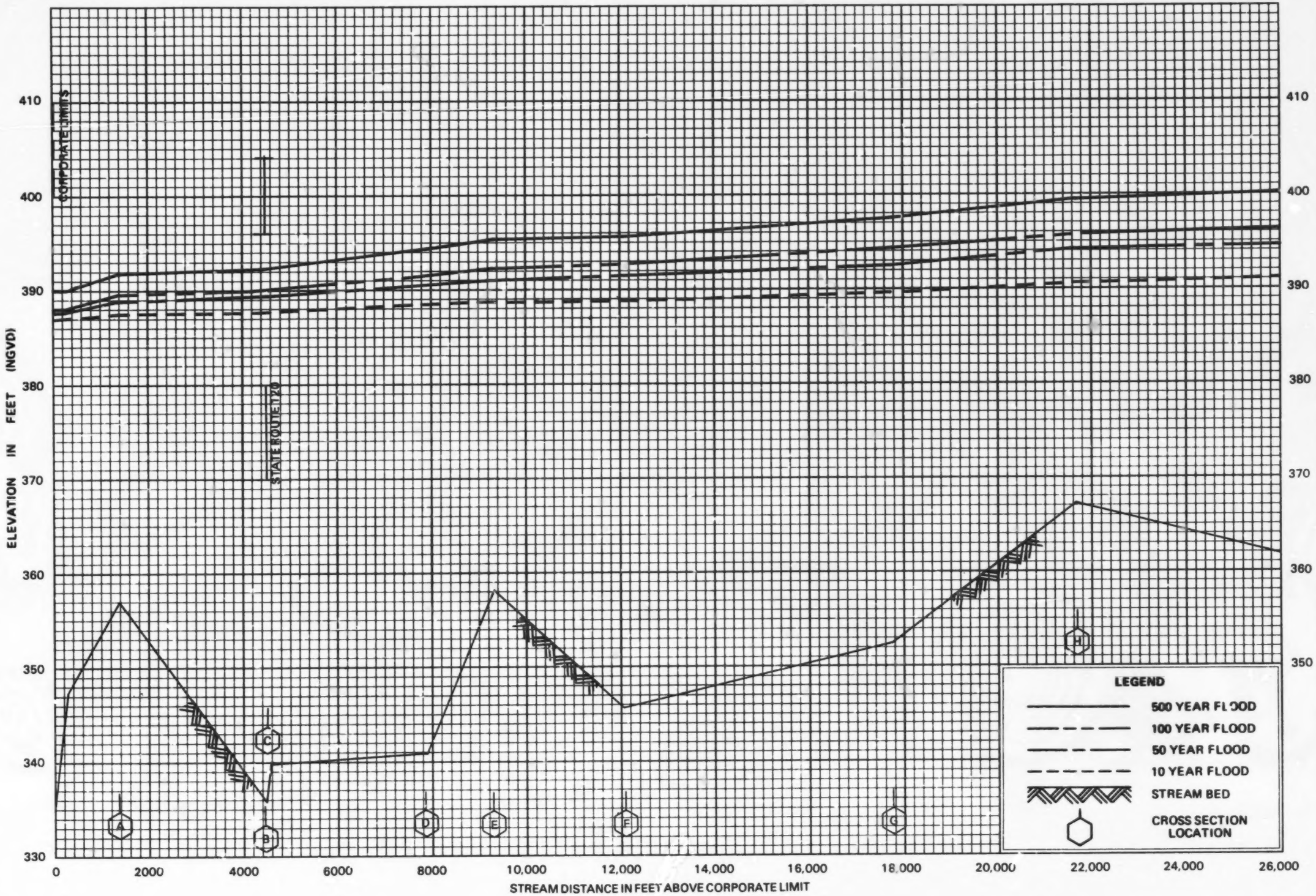
Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 8	03	403.79	Chiseled square on northeast concrete headwall of culvert under U. S. Route 132.
RM 9	03	390.94	Chiseled square on east wall of culvert on Campbell Flat Road on north side of Ompompanoosuc River, approximately 0.4 mile north of RM 11.
RM 10	03	415.96	SCS aluminum disk and nail in 30 inch white pine between GMPC poles 43 and 44 on north side of State Route 132.
RM 11	03	399.08	Chiseled square in southeast wing wall of State Route 132 bridge over Ompompanoosuc River.
RM 12	08	830.32	Chiseled square on upstream headwall of Bloody Brook culvert under Turnpike Road, approximately 1.7 miles north of RM 18.
RM 13	08	814.38	Chiseled square on stone headwall of culvert under Turnpike Road, approximately 1.5 miles north of RM 18.
RM 14	08	757.90	Chiseled square on headwall of 24 inch culvert under Turnpike Road, approximately 1.1 miles north of RM 18.
RM 15	08	722.43	Chiseled square on southeast abutment of Turnpike Road bridge over Bloody Brook, approximately 0.76 miles north of RM 19.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 16	08	701.51	Chiseled square on southeast abutment of concrete Turnpike Road bridge over Bloody Brook, approximately 0.6 mile north of RM 18.
RM 17	08	652.43	Chiseled square on stone headwall of culvert under Turnpike Road, approximately 0.25 mile north of RM 18.
RM 18	08	634.21	Chiseled square on southeast abutment of concrete Turnpike Road bridge over Bloody Brook, approximately 0.1 mile north of RM 19.
RM 19	08	622.36	Chiseled square on southeast abutment of Turnpike Road over Bloody Brook, just upstream of confluence with New Boston Brook.
RM 20	08	851.27	Railroad spike in bottom of 12 inch ash tree on east side of New Boston Road approximately 1.2 miles north of intersection of Turnpike Road and New Boston Road.
RM 21	08	812.21	Standard USGS disk on New Boston Road 1 mile north of intersection with Turnpike Road.
RM 22	08	729.95	Chiseled square in upstream abutment of New Boston Road bridge over New Boston Brook.
RM 23	12	597.05	Chiseled square on northeast abutment of Turnpike Road bridge over Bloody Brook, approximately 1.3 miles north of Aldrich House.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 24	12	552.41	Chiseled and painted mark at high point of ledge outcrop on Beaver Meadow Road, approximately 0.6 mile north of Aldrich House.
RM 25	12	520.99	Chiseled square on southeast abutment of Beaver Meadow Road bridge over Bloody Brook, approximately 0.25 mile west of Aldrich House.
RM 26	12	494.79	Chiseled square in southwest abutment of Hopson Road bridge over Bloody Brook, approximately 0.3 mile west of Aldrich House.
RM 27	12	481.69	Chiseled square in southeast abutment of Elm Street bridge over Bloody Brook, approximately 0.4 mile southwest of Aldrich House.
RM 28	12	536.61	USGS disk on side of Aldrich House in Norwich, Vermont.



FLOOD PROFILES

CONNECTICUT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT
(WINDSOR COUNTY)

01P

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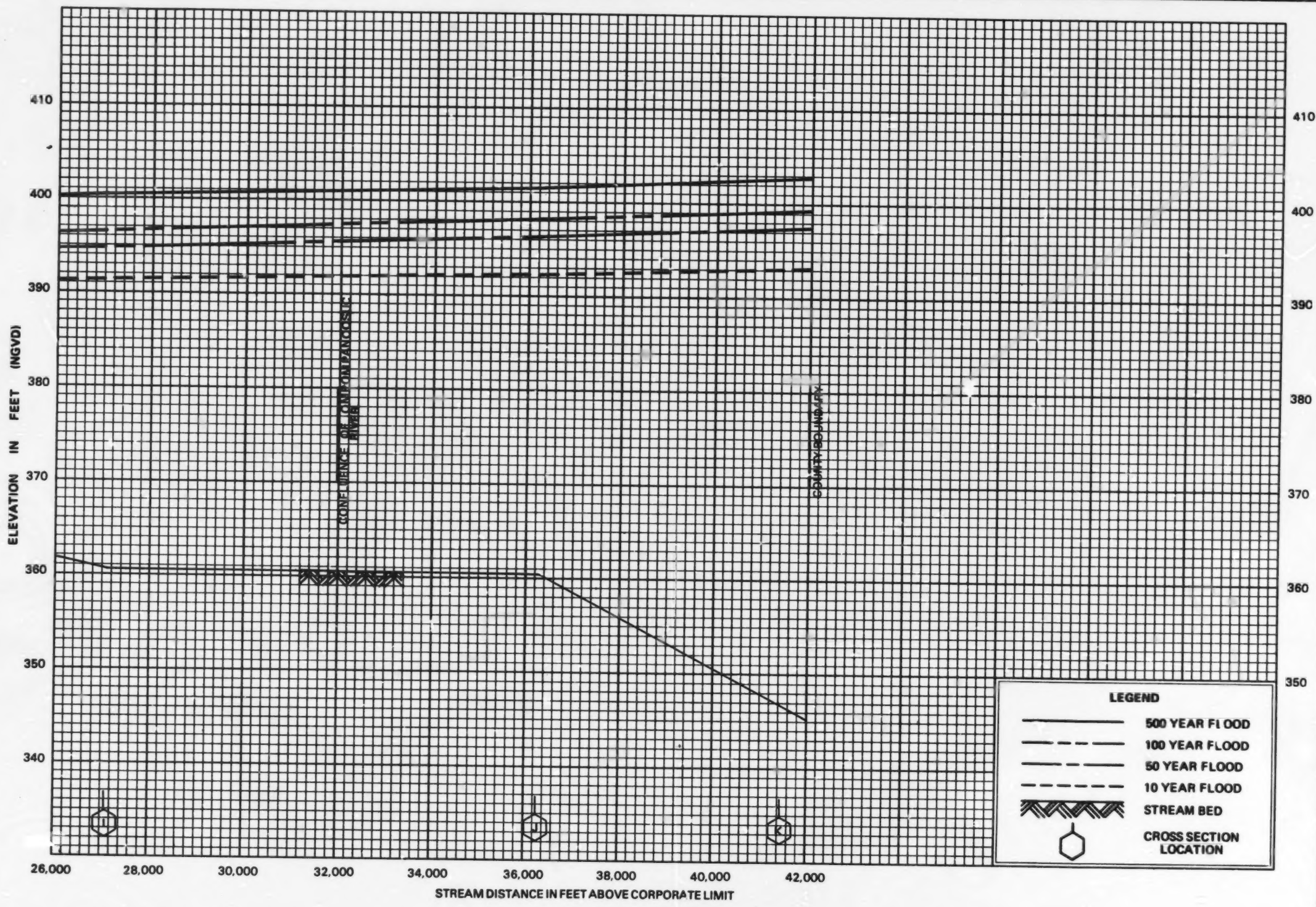

FLOOD PROFILES

CONNECTICUT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT
(WINDSOR COUNTY)

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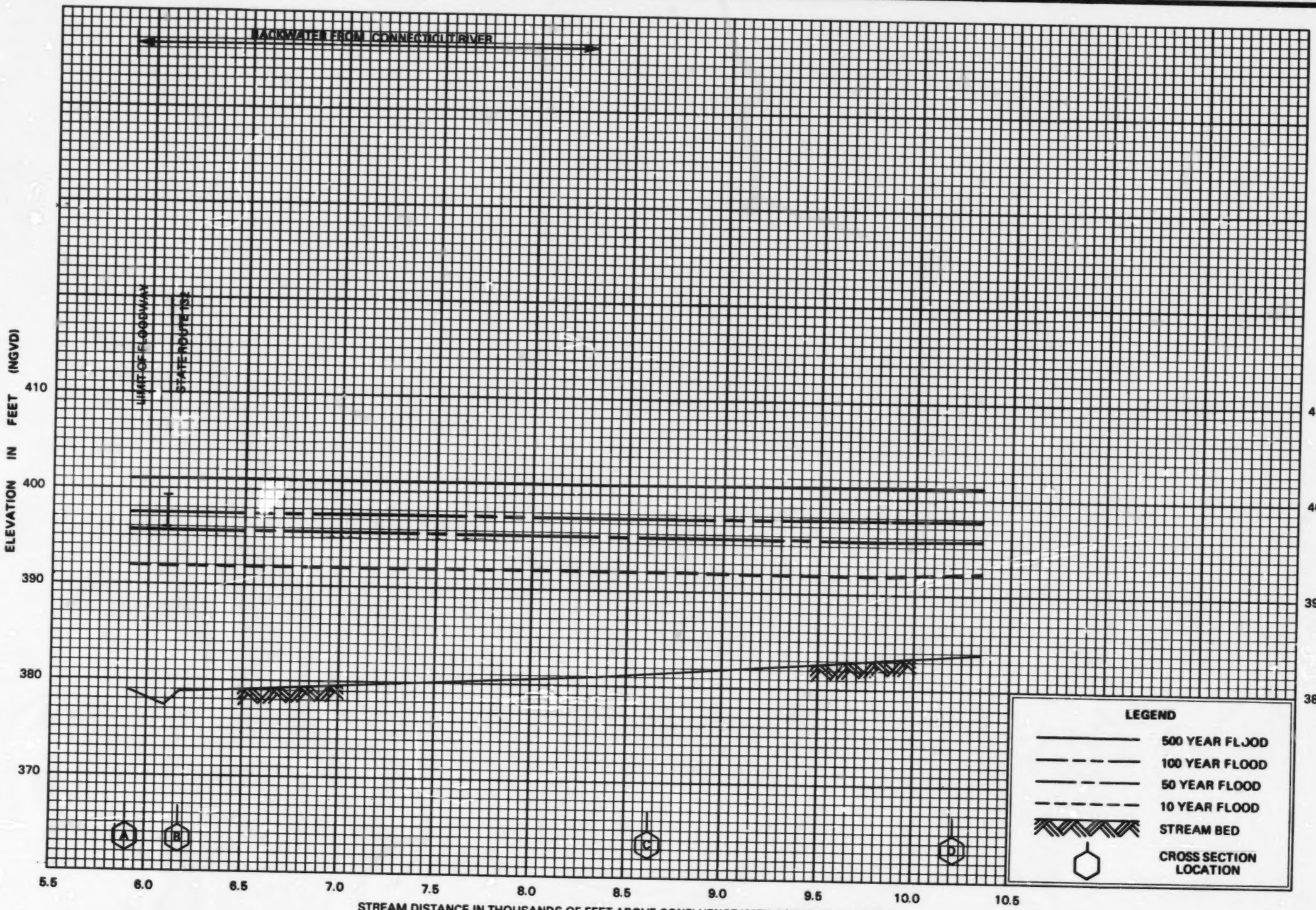

FLOOD PROFILES

OMPOMPANOOSUC RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT
(WINDSOR COUNTY)

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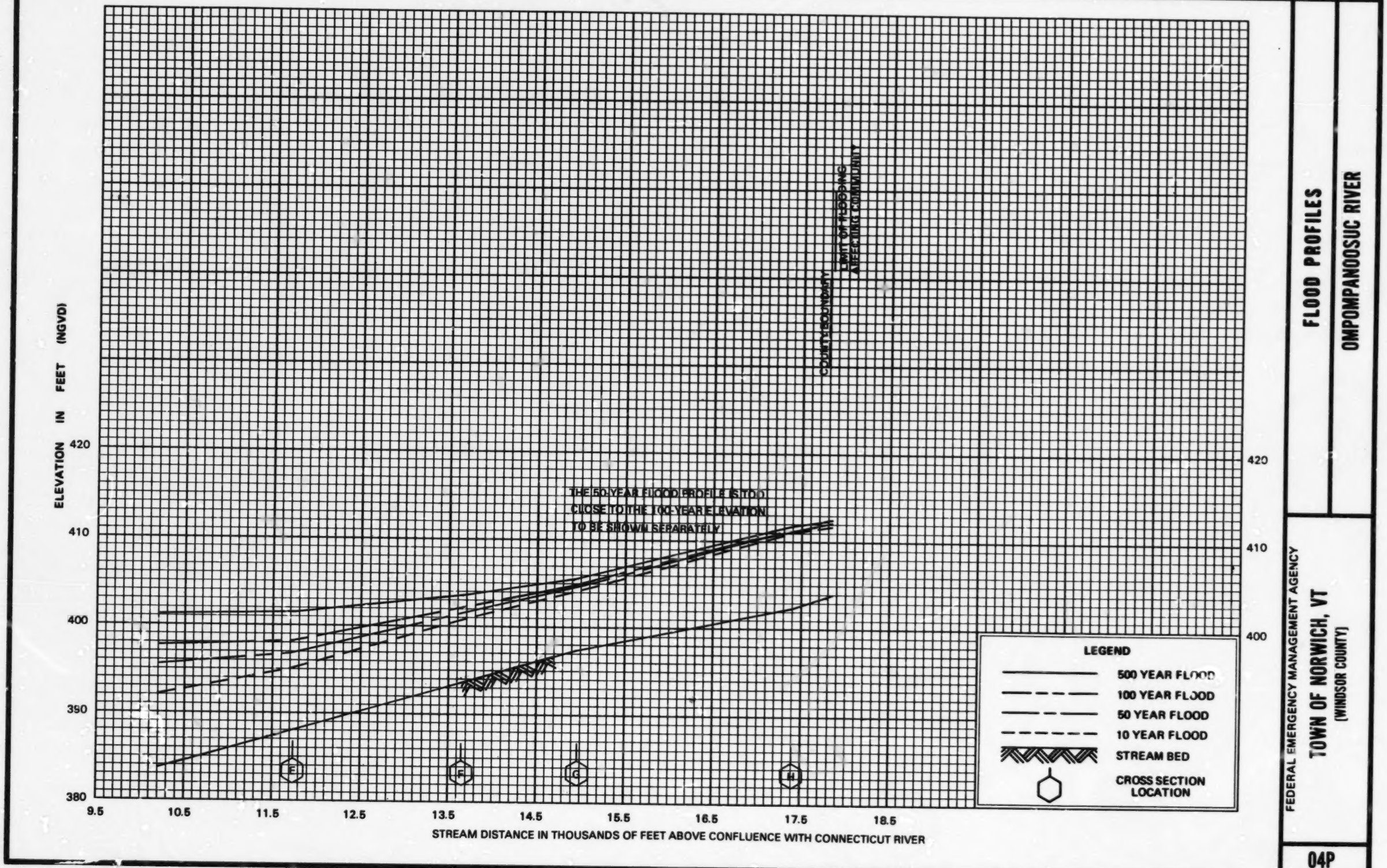

FLOOD PROFILES

OMPOMPANOOSUC RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT

(WINDSOR COUNTY)

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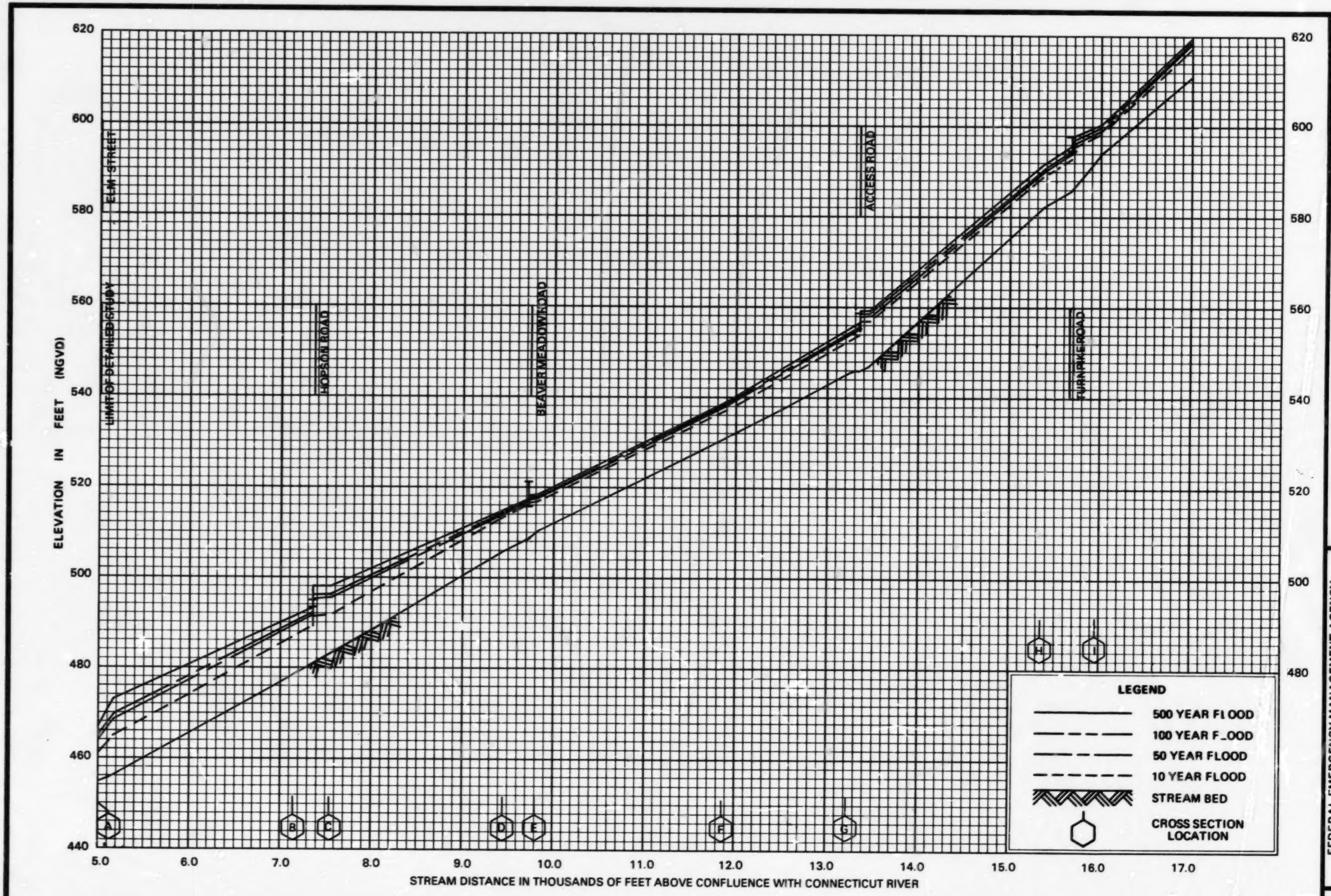

FLOOD PROFILES

BLOODY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT
(WINDSOR COUNTY)

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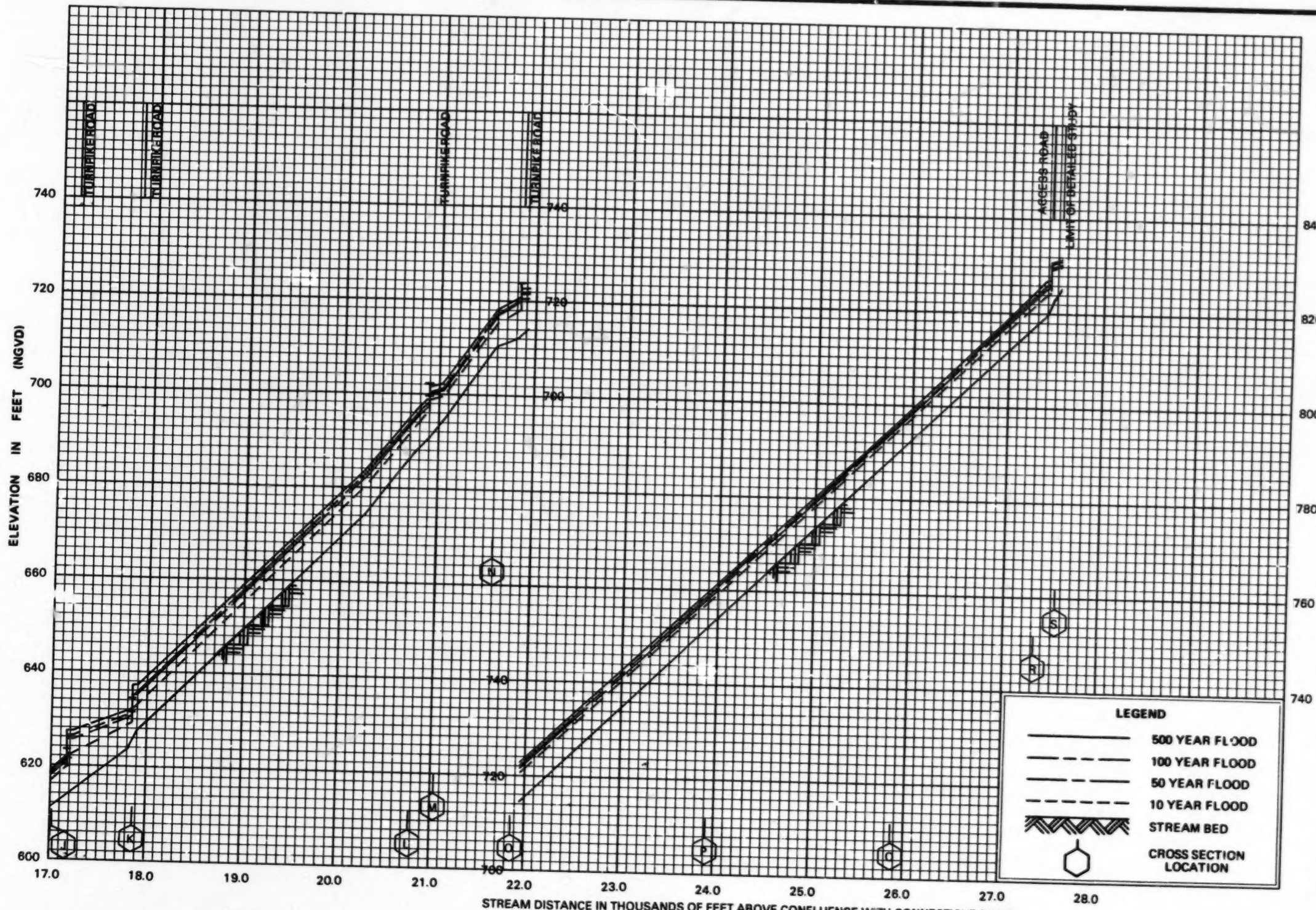

FLOOD PROFILES

BLOODY BROOK

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(WINDSOR COUNTY)

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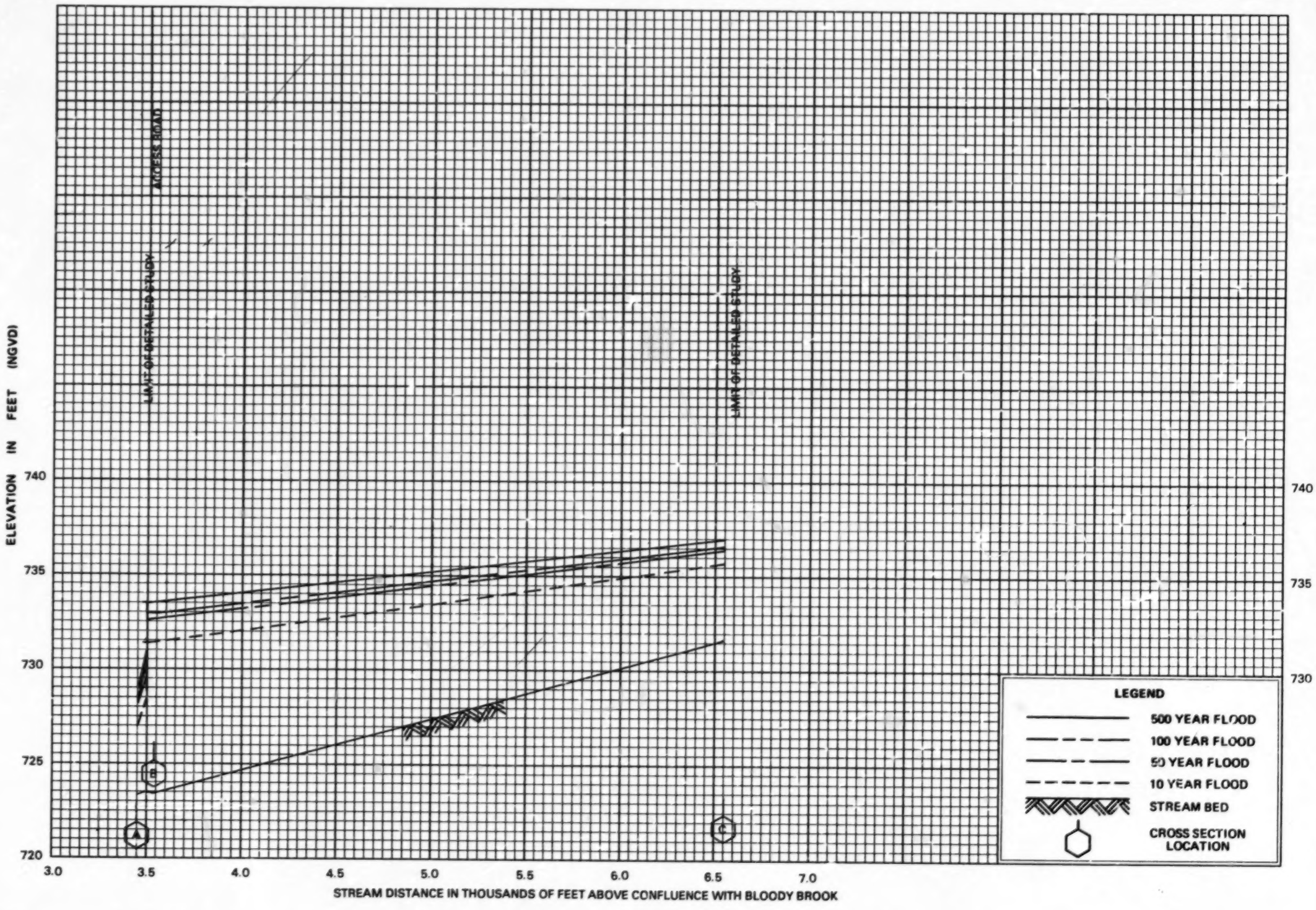

FLOOD PROFILES

NEW BOSTON BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NORWICH, VT
(WINDSOR COUNTY)

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